

# PCT

## REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference  
(if desired) (12 characters maximum)

AZ00-0175WO

<b>Box No. I TITLE OF INVENTION</b>	
ABSOLUTE HUMIDITY SENSOR	
<b>Box No. II APPLICANT</b>	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)	
LG ELECTRONICS INC.  20, Yoido-dong, Youngdungpo-gu, Seoul, 150-010, Republic of Korea	
<input type="checkbox"/> This person is also inventor.	
Telephone No. (82) (02) 3777-7093	
Facsimile No. (82) (02) 3777-5151	
Teleprinter No.	
State (that is, country) of nationality: KR	State (that is, country) of residence: KR
This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input checked="" type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box	
<b>Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)</b>	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)	
LEE, Don Hee  Samik APT., 1-1109, 572, Pisan-dong, Tongan-gu, Anyang-shi, Kyonggi-do, 431-050, Republic of Korea	
This person is: <input type="checkbox"/> applicant only <input checked="" type="checkbox"/> applicant and inventor <input type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)	
State (that is, country) of nationality: KR	State (that is, country) of residence: KR
This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box	
<input checked="" type="checkbox"/> Further applicants and/or (further) inventors are indicated on a continuation sheet.	
<b>Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE</b>	
The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: <input checked="" type="checkbox"/> agent <input type="checkbox"/> common representative	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)	
KIM, Yong In, KANG, Yong Bok  15th Floor, Yo Sam Bldg., 648-23 Yeoksam-dong, Kangnam-ku, Seoul, 135-080, Republic of Korea	
Telephone No. (82) (02) 3453-6701	
Facsimile No. (82) (02) 557-3404	
Teleprinter No.	
<input type="checkbox"/> Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.	

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)	
<i>If none of the following sub-boxes is used, this sheet should not be included in the request.</i>	
<p>Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</i></p> <p>BU, Jong Uk Hanjin APT., 701-1303, Chongja-dong, Pundang-gu, Songnam-shi, Kyonggi-do, 463-010, Republic of Korea</p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input checked="" type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only <i>(If this check-box is marked, do not fill in below.)</i></p>
State <i>(that is, country)</i> of nationality: KR	State <i>(that is, country)</i> of residence: KR
<p>This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p>Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</i></p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only <i>(If this check-box is marked, do not fill in below.)</i></p>
State <i>(that is, country)</i> of nationality:	State <i>(that is, country)</i> of residence:
<p>This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p>Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</i></p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only <i>(If this check-box is marked, do not fill in below.)</i></p>
State <i>(that is, country)</i> of nationality:	State <i>(that is, country)</i> of residence:
<p>This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p>Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</i></p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only <i>(If this check-box is marked, do not fill in below.)</i></p>
State <i>(that is, country)</i> of nationality:	State <i>(that is, country)</i> of residence:
<p>This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p><input type="checkbox"/> Further applicants and/or (further) inventors are indicated on another continuation sheet.</p>	

**Bdx No.V DESIGNATION OF STATES**

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

**Regional Patent**

- ☒ **AP ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ **EA Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ **EP European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ **OA OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

**National Patent** (if other kind of protection or treatment desired, specify on dotted line):

- |   |   |
|---|---|
| <input checked="" type="checkbox"/> <b>AE</b> United Arab Emirates                  | <input checked="" type="checkbox"/> <b>LR</b> Liberia                                   |
| <input checked="" type="checkbox"/> <b>AL</b> Albania                               | <input checked="" type="checkbox"/> <b>LS</b> Lesotho                                   |
| <input checked="" type="checkbox"/> <b>AM</b> Armenia                               | <input checked="" type="checkbox"/> <b>LT</b> Lithuania                                 |
| <input checked="" type="checkbox"/> <b>AT</b> Austria                               | <input checked="" type="checkbox"/> <b>LU</b> Luxembourg                                |
| <input checked="" type="checkbox"/> <b>AU</b> Australia                             | <input checked="" type="checkbox"/> <b>LV</b> Latvia                                    |
| <input checked="" type="checkbox"/> <b>AZ</b> Azerbaijan                            | <input checked="" type="checkbox"/> <b>MA</b> Morocco                                   |
| <input checked="" type="checkbox"/> <b>BA</b> Bosnia and Herzegovina                | <input checked="" type="checkbox"/> <b>MD</b> Republic of Moldova                       |
| <input checked="" type="checkbox"/> <b>BB</b> Barbados                              | <input checked="" type="checkbox"/> <b>MG</b> Madagascar                                |
| <input checked="" type="checkbox"/> <b>BG</b> Bulgaria                              | <input checked="" type="checkbox"/> <b>MK</b> The former Yugoslav Republic of Macedonia |
| <input checked="" type="checkbox"/> <b>BR</b> Brazil                                | <input checked="" type="checkbox"/> <b>MN</b> Mongolia                                  |
| <input checked="" type="checkbox"/> <b>BY</b> Belarus                               | <input checked="" type="checkbox"/> <b>MW</b> Malawi                                    |
| <input checked="" type="checkbox"/> <b>CA</b> Canada                                | <input checked="" type="checkbox"/> <b>MX</b> Mexico                                    |
| <input checked="" type="checkbox"/> <b>CH and LI</b> Switzerland and Liechtenstein  | <input checked="" type="checkbox"/> <b>NO</b> Norway                                    |
| <input checked="" type="checkbox"/> <b>CN</b> China                                 | <input checked="" type="checkbox"/> <b>NZ</b> New Zealand                               |
| <input checked="" type="checkbox"/> <b>CR</b> Costa Rica                            | <input checked="" type="checkbox"/> <b>PL</b> Poland                                    |
| <input checked="" type="checkbox"/> <b>CU</b> Cuba                                  | <input checked="" type="checkbox"/> <b>PT</b> Portugal                                  |
| <input checked="" type="checkbox"/> <b>CZ</b> Czech Republic                        | <input checked="" type="checkbox"/> <b>RO</b> Romania                                   |
| <input checked="" type="checkbox"/> <b>DE</b> Germany                               | <input checked="" type="checkbox"/> <b>RU</b> Russian Federation                        |
| <input checked="" type="checkbox"/> <b>DK</b> Denmark                               | <input checked="" type="checkbox"/> <b>SD</b> Sudan                                     |
| <input checked="" type="checkbox"/> <b>DM</b> Dominica                              | <input checked="" type="checkbox"/> <b>SE</b> Sweden                                    |
| <input checked="" type="checkbox"/> <b>EE</b> Estonia                               | <input checked="" type="checkbox"/> <b>SG</b> Singapore                                 |
| <input checked="" type="checkbox"/> <b>ES</b> Spain                                 | <input checked="" type="checkbox"/> <b>SI</b> Slovenia                                  |
| <input checked="" type="checkbox"/> <b>FI</b> Finland                               | <input checked="" type="checkbox"/> <b>SK</b> Slovakia                                  |
| <input checked="" type="checkbox"/> <b>GB</b> United Kingdom                        | <input checked="" type="checkbox"/> <b>SL</b> Sierra Leone                              |
| <input checked="" type="checkbox"/> <b>GD</b> Grenada                               | <input checked="" type="checkbox"/> <b>TJ</b> Tajikistan                                |
| <input checked="" type="checkbox"/> <b>GE</b> Georgia                               | <input checked="" type="checkbox"/> <b>TM</b> Turkmenistan                              |
| <input checked="" type="checkbox"/> <b>GH</b> Ghana                                 | <input checked="" type="checkbox"/> <b>TR</b> Turkey                                    |
| <input checked="" type="checkbox"/> <b>GM</b> Gambia                                | <input checked="" type="checkbox"/> <b>TT</b> Trinidad and Tobago                       |
| <input checked="" type="checkbox"/> <b>HR</b> Croatia                               | <input checked="" type="checkbox"/> <b>TZ</b> United Republic of Tanzania               |
| <input checked="" type="checkbox"/> <b>HU</b> Hungary                               | <input checked="" type="checkbox"/> <b>UA</b> Ukraine                                   |
| <input checked="" type="checkbox"/> <b>ID</b> Indonesia                             | <input checked="" type="checkbox"/> <b>UG</b> Uganda                                    |
| <input checked="" type="checkbox"/> <b>IL</b> Israel                                | <input checked="" type="checkbox"/> <b>US</b> United States of America                  |
| <input checked="" type="checkbox"/> <b>IN</b> India                                 |   |
| <input checked="" type="checkbox"/> <b>IS</b> Iceland                               | <input checked="" type="checkbox"/> <b>UZ</b> Uzbekistan                                |
| <input checked="" type="checkbox"/> <b>JP</b> Japan                                 | <input checked="" type="checkbox"/> <b>VN</b> Viet Nam                                  |
| <input checked="" type="checkbox"/> <b>KE</b> Kenya                                 | <input checked="" type="checkbox"/> <b>YU</b> Yugoslavia                                |
| <input checked="" type="checkbox"/> <b>KG</b> Kyrgyzstan                            | <input checked="" type="checkbox"/> <b>ZA</b> South Africa                              |
| <input checked="" type="checkbox"/> <b>KP</b> Democratic People's Republic of Korea | <input checked="" type="checkbox"/> <b>ZW</b> Zimbabwe                                  |
| <input type="checkbox"/> <b>KR</b> Republic of Korea                                |   |
| <input checked="" type="checkbox"/> <b>KZ</b> Kazakhstan                            |   |
| <input checked="" type="checkbox"/> <b>LC</b> Saint Lucia                           |   |
| <input checked="" type="checkbox"/> <b>LK</b> Sri Lanka                             |   |

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

- ☐   
 ☐

**Precautionary Designation Statement:** In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)

<b>Box No. VI PRIORITY CLAIM</b>		<input type="checkbox"/> Further priority claims are indicated in the Supplemental Box.		
Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: regional Office	international application: receiving Office
item (1) 13, December 1999 (13. 12.1999)	1999-57196	KR		
item (2)				
item (3)				
<input type="checkbox"/> The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s):				
<i>* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.</i>				
<b>Box No. VII INTERNATIONAL SEARCHING AUTHORITY</b>				
<b>Choice of International Searching Authority (ISA)</b> (if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):		<b>Request to use results of earlier search; reference to that search</b> (if an earlier search has been carried out by or requested from the International Searching Authority):		
ISA / AT		Date (day/month/year)	Number	Country (or regional Office)
<b>Box No. VIII CHECK LIST: LANGUAGE OF FILING</b>				
This international application contains the following number of sheets: request : 4 description (excluding sequence listing part) : 11 claims : 2 abstract : 1 drawings : 5 sequence listing part of description : _____ Total number of sheets : 23		This international application is accompanied by the item(s) marked below: 1. <input checked="" type="checkbox"/> fee calculation sheet 2. <input checked="" type="checkbox"/> separate signed power of attorney 3. <input type="checkbox"/> copy of general power of attorney; reference number, if any: 4. <input type="checkbox"/> statement explaining lack of signature 5. <input checked="" type="checkbox"/> priority document(s) identified in Box No. VI as item(s): (1) 6. <input type="checkbox"/> translation of international application into (language): 7. <input type="checkbox"/> separate indications concerning deposited microorganism or other biological material 8. <input type="checkbox"/> nucleotide and/or amino acid sequence listing in computer readable form 9. <input type="checkbox"/> other (specify):		
Figure of the drawings which should accompany the abstract: 2A		Language of filing of the international application: English		
<b>Box No. IX SIGNATURE OF APPLICANT OR AGENT</b>				
Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).				
KIM, Yong In		(Seal)		
KANG, Yong Bok		(Seal)		

For receiving Office use only		2. Drawings:  <input type="checkbox"/> received:  <input type="checkbox"/> not received:
1. Date of actual receipt of the purported international application:		
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:		
4. Date of timely receipt of the required corrections under PCT Article 11(2):		
5. International Searching Authority (if two or more are competent): ISA /		6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid.

For International Bureau use only	
Date of receipt of the record copy by the International Bureau:	

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>AZ00-0175WO</b>	FOR FURTHER ACTION      see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/KR 00/01440</b>	International filing date (day/month/year) <b>12 December 2000 (12.12.2000)</b>	(Earliest) Priority Date (day/month/year) <b>13 December 1999 (13.12.1999)</b>
Applicant <b>LG ELECTRONICS INC.</b>		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ **Certain claims were found unsearchable** (See Box I)

3. ☐ **Unity of invention is lacking** (See Box II).

4. With regard to the **title**.

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**.

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.: 2A

☒ as suggested by the applicant.

☐ None of the figures.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR 00/01440

## CLASSIFICATION OF SUBJECT MATTER

IPC<sup>7</sup>: G01N 27/12

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC<sup>7</sup>: G01N 27/12, G01N 27/22, G01N 27/18

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2194845 A (SHARP) 16 March 1988 (16.03.88)	1-3,5-7
Y	the whole document.	4,8,9
Y	WO 91/03734 A1 (AT & S) 21 March 1991 (21.03.91)	4
Y	abstract.	
Y	EP 021225 A1 (SHIBAURA DENSHI) 7 January 1981 (07.01.81)	8,9
	fig. 2.	
	----	



Further documents are listed in the continuation of Box C.



See patent family annex.

## \* Special categories of cited documents:

..A" document defining the general state of the art which is not considered to be of particular relevance

..E" earlier application or patent but published on or after the international filing date

..L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

..O" document referring to an oral disclosure, use, exhibition or other means

..P" document published prior to the international filing date but later than the priority date claimed

..T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

..X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

..Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

..&amp;" document member of the same patent family

Date of the actual completion of the international search

16 March 2001 (16.03.2001)

Date of mailing of the international search report

30 March 2001 (30.03.2001)

Name and mailing address of the ISA/AT

Austrian Patent Office

Kohlmarkt 8-10; A-1014 Vienna

Facsimile No. 1/53424/535

Authorized officer

NARDAI

Telephone No. 1/53424/347

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR 00/01440

Patent document cited in search report			Publication date	Patent family member(s)	Publication date
EP	A	021225		none	
GB	A1	2194845	16-03-1988	DE A1 3724966	04-02-1988
GB	B2	2194845	24-10-1990	DE C2 3724966	26-10-1989
				DE C3 3724966	21-03-1996
				GB A0 8717919	03-09-1987
				US A 4928513	29-05-1990
				JP A2 63145954	18-06-1988
				JP A2 63263426	31-10-1988
				JP B4 7095002	11-10-1995
				JP A2 63289443	25-11-1988
				JP A2 63293459	30-11-1988
WO	A1	9103734	21-03-1991	DE C0 59010077	29-02-1996
				EP A1 489825	17-06-1992
				EP A1 489826	17-06-1992
				EP B1 489826	17-01-1996
				FI A0 920916	28-02-1992
				FI A0 920917	28-02-1992
				FI B1 100618	15-01-1998
				JP T2 5505234	05-08-1993
				JP T2 5506711	30-09-1993
				US A 5348761	20-09-1994
				WO A1 9103735	21-03-1991
				AT A 571/90	15-07-1997
				AT B 403527	25-03-1998

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
14 June 2001 (14.06.2001)

PCT

(10) International Publication Number  
**WO 01/42775 A1**

(51) International Patent Classification<sup>7</sup>: **G01N 27/12**

Uk [KR/KR]; Hanjin APT., 701-1303, Chongja-dong, Pundang-gu, Songnam-shi, Kyonggi-do 463-010 (KR).

(21) International Application Number: **PCT/KR00/01440**

(74) Agents: **KIM, Yong, In et al.**; 15th Floor, Yo Sam Bldg., 648-23, Yeoksam-dong, Kangnam-ku, Seoul 135-080 (KR).

(22) International Filing Date:  
12 December 2000 (12.12.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
1999/57196 13 December 1999 (13.12.1999) KR

(81) Designated States (*national*): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(71) Applicant (*for all designated States except US*): **LG ELECTRONICS INC.** [KR/KR]; 20, Yoido-dong, Youngdungpo-gu, Seoul 150-010 (KR).

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

(72) Inventors; and

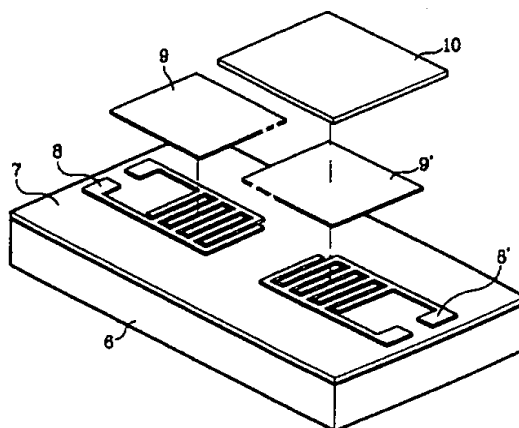
(75) Inventors/Applicants (*for US only*): **LEE, Don, Hee** [KR/KR]; Samik APT., 1-1109, 572, Pisan-dong, Tongan-gu, Anyang-shi, Kyonggi-do 431-050 (KR). **BU, Jong,**

Published:

— *With international search report.*

[Continued on next page]

(54) Title: **ABSOLUTE HUMIDITY SENSOR**



(57) Abstract: An absolute humidity sensor for a microwave oven is disclosed. The absolute humidity sensor includes a silicon substrate, a humidity sensing element formed on a substrate, for detecting humidity exposed to the air, having a variable resistance value depending on the amount of the humidity, a temperature compensating element formed on the semiconductor, for compensating for the resistance value of the humidity sensing element, and a passivation film covered on the temperature compensating element, for shielding the humidity exposed to the air so as not to vary the resistance value of the temperature compensating element. The humidity sensing element and the temperature compensating element include an insulating film formed on the substrate, a humidity sensing film formed on the insulating film, for absorbing the humidity, and an electrode formed below the humidity sensing film or over/below the humidity sensing film. A polyimide thin film, which absorbs the humidity greater than a ceramic based humidity sensing material, is used as a humidity sensing material, and a silicon wafer is used as a substrate. Thus, an absolute humidity sensor susceptible to humidity can be fabricated and at the same time the sensor is integrated using a silicon process to facilitate its mass production.

WO 01/42775 A1





*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## ABSOLUTE HUMIDITY SENSOR

Technical Field

The present invention relates to an absolute humidity sensor, and  
5 more particularly, to an absolute humidity sensor for a microwave oven.

Background Art

Generally, a humidity sensor is used for various purposes, for  
10 example, in a hygrometer, a humidity sensor for cooking of food in a  
microwave oven, and the like. Examples of currently used humidity sensors  
include a capacitance type humidity sensor, a relative humidity sensor,  
and an absolute humidity sensor. The capacitance type humidity sensor is  
based on variation of dielectric constants by hygroscopic property of an  
15 organic material such as polyimide. The relative humidity sensor is based  
on resistance variation of a semiconductor ceramic such as  $\text{MgCr}_2\text{O}_4$ . The  
absolute humidity sensor is based on a ceramic thermistor.

Of the humidity sensors, the absolute humidity sensor based on two  
thermistors is widely used as a humidity sensor for cooking of food in  
20 a microwave oven.

The absolute humidity sensor has an advantage in that it can stably  
detect the humidity because it is not susceptible to variation of a  
peripheral temperature.

The principles of sensing humidity of the absolute humidity sensor  
25 in the microwave oven are based on resistance variation by temperature  
variation of a thermistor as vapor generated from food during cooking of

food absorbs heat of the thermistor.

Fig. 1 shows a structure of a background art absolute humidity sensor. Referring to Fig. 1, two ceramic thermistors 1 and 2 coated with a passivation film such as a glass film are floating by being connected to a support pin 4 by a precious metal conductor 3 such as platinum. The ceramic thermistors 1 and 2 are packaged by a metal shield case 5 that isolates the two thermistors 1 and 2 from each other.

The thermistor 1 is exposed to the air to allow vapor to be in contact with a surface of the thermistor 1 by means of a fine hole of the metal shield case 5. The thermistor 1 is used as a sensing element. The other thermistor 2 is sealed in a dry  $N_2$  by the metal shield case 5 so as not to be in contact with the vapor. The thermistor 2 is used as a reference element.

Therefore, if a bridge circuit consists of the two thermistors 1 and 2 and an external resistor, the vapor generated from food during cooking of food absorbs heat of the thermistor 1 exposed to the air. Thus, resistance variation occurs in only the exposed thermistor 1. In this case, output variation occurs due to a bias voltage, thereby detecting the humidity.

Since the background art humidity sensor uses an element as a ceramic thermistor, heat capacity is great and thus sensitivity is low. Also, response time is slow and the size of the sensor becomes greater.

Furthermore, the thermistor element is floating using the conductor 3 and the support pin 4 as shown in Fig. 1, and the conductor 3 and the pin 4 are spot-welded. For assembly, the reference element 2 should be sealed in a dry  $N_2$ . For this reason, the fabrication process

steps are complicate and the number of the process steps increases. Also, the cost is expensive and mass production is disadvantageous.

#### Disclosure of the Invention

5       Accordingly, the present invention is directed to an absolute humidity sensor that substantially obviates one or more of the problems due to limitations and disadvantages of the background art.

      An object of the present invention is to provide an absolute humidity sensor having excellent humidity hygroscopic property.

10       Another object of the present invention is to provide an absolute humidity sensor having simple process steps to facilitate mass production.

      Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from  
15 the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

      To achieve these and other advantages and in accordance with the  
20 purpose of the present invention, as embodied and broadly described, an absolute humidity sensor according to the present invention includes a silicon substrate, a humidity sensing element formed on a substrate, for detecting humidity exposed to the air, having a variable resistance value depending on the amount of the humidity, a temperature compensating  
25 element formed on the semiconductor, for compensating for the resistance value of the humidity sensing element, and a passivation film covered on

the temperature compensating element, for shielding the humidity exposed to the air so as not to vary the resistance value of the temperature compensating element.

In the preferred embodiment of the present invention, the humidity sensing element and the temperature compensating element include an insulating film formed on the substrate, a humidity sensing film formed on the insulating film, for absorbing the humidity, and an electrode formed below the humidity sensing film or over/below the humidity sensing film.

The insulating film and the passivation film are formed of any one of  $\text{SiO}_2$ ,  $\text{Si}_3\text{N}_4$ , and  $\text{SiO}_x\text{N}_y$ . The humidity sensing film is formed of polyimide annealed at a temperature of 200~300°C. The electrode uses a comb electrode.

The absolute humidity sensor according to the present invention further includes a printed circuit board joined with a lower portion of the silicon substrate, a wire which electrically connects electrodes of the humidity sensing element and the temperature compensating element with electrodes of the printed circuit board, and a metal shield case formed over the printed circuit board to cover an entire surface of the printed circuit board including the humidity sensing element and the temperature compensating element.

In the preferred embodiment of the present invention, a polyimide thin film, which absorbs the humidity greater than a ceramic based humidity sensing material, is used as a humidity sensing material, and a silicon wafer is used as a substrate. Thus, an absolute humidity sensor susceptible to humidity can be fabricated and at the same time the sensor

is integrated using a silicon process to facilitate its mass production.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

5

#### Brief Description of the Drawings

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

In the drawings:

Fig. 1 is a structural sectional view showing a background art of an absolute humidity sensor;

15 Figs. 2a and 2b are structural perspective views showing a resistance type absolute humidity sensor according to the present invention;

Figs. 3a and 3b are structural perspective views showing a capacitance type absolute humidity sensor according to the present invention;

20 Figs. 4a and 4b show a structure of an absolute humidity sensor package according to the present invention; and

Fig. 5 is a circuit diagram for detecting the humidity based on the resistance type absolute humidity sensor according to the present invention.

25

### Best Mode for Carrying Out the Invention

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

#### 5     First Embodiment

Figs. 2a and 2b are structural perspective views showing a resistance type absolute humidity sensor according to the present invention.

As shown in Fig. 2a, an insulating film 7 of  $\text{SiO}_2$ ,  $\text{Si}_3\text{N}_4$ , or  $\text{SiO}_x\text{N}_y$  is formed on a silicon substrate 6. A metal film such as Al or Pt is deposited on the insulating film 7 and then patterned to form a pair of electrodes 8 and 8' in a comb shape.

Afterwards, a polyimide thin film is spin-coated on the electrode and then patterned to form a humidity sensing film 9 for a humidity sensing element and a humidity sensing film 9' for a temperature compensating element.

The polyimide is imidized at a temperature of about  $200^\circ\text{C}$  or greater. The polyimide has a thermal decomposition temperature of about  $450\sim 500^\circ\text{C}$ . Accordingly, the polyimide has excellent thermal stability.

20     Also, the polyimide has a hygroscopic property as follows.

An equilibrium value of an aqueous molecule absorbed into the polyimide at a room temperature under the ambient of a relative humidity ambient of 80% is about 2.3wt%. The polyimide absorbs humidity more than a ceramic based humidity sensing material. Moreover, a diffusion coefficient of the aqueous molecule within a polyimide thin film is approximately  $5 \times 10^{-9} \text{cm}^2/\text{sec}$  at a room temperature. Accordingly, high

response time can be obtained.

The polyimide thin film has a compact film tissue when annealing is performed at a high temperature of about 300°C or greater. In this case, it is difficult to propagate the humidity into the film. To use the polyimide thin film as a humidity sensing element, the annealing process is preferably performed at a temperature between 200°C and 300°C to obtain high hygroscopic ratio of the polyimide film.

After the humidity sensing films 9 and 9' are formed, a ceramic thin film such as  $\text{SiO}_2$ ,  $\text{Si}_3\text{N}_4$ , and  $\text{SiO}_x\text{N}_y$  is deposited on the humidity sensing film 9' for a temperature compensating element and then patterned, so that the humidity is not propagated into the humidity sensing film 9'. Thus, a passivation film 10 is formed.

In the resistance type absolute humidity sensor fabricated as above, it is noted that, as shown in Fig. 2b, the humidity sensing element and the temperature compensating element are formed on the same silicon substrate 6.

#### Second Embodiment

Figs. 3a and 3b are structural perspective views showing a capacitance type absolute humidity sensor according to the present invention.

As shown in Fig. 3a, an insulating film 12 of  $\text{SiO}_2$ ,  $\text{Si}_3\text{N}_4$ , or  $\text{SiO}_x\text{N}_y$  is formed on a silicon substrate 11. A metal film such as Al or Pt is deposited on the insulating film 12 and then patterned to form a lower electrode 13 for a humidity sensing element and a lower electrode 13' for a temperature compensating element.

Afterwards, a polyimide thin film is spin-coated on the lower



electrodes 13 and 13' and then patterned to form a humidity sensing film 14 for a humidity sensing element and a humidity sensing film 14' for a temperature compensating element. Subsequently, an annealing process is performed at a temperature between 200°C and 300°C.

5       The metal film having the same material as that of the lower electrodes 13 and 13' is deposited on the polyimide humidity sensing films 14 and 14' and then patterned to form an upper electrode 15 for a humidity sensing element and an upper electrode 15' for a temperature compensating element in a comb shape. Thus, a parallel capacitor  
10 structure is formed in such a manner that the polyimide humidity sensing film is formed between the upper and lower electrodes.

Unlike the lower electrodes 13 and 13', the upper electrodes 15 and 15' are formed in a comb shape to allow an aqueous molecule to smoothly pass through the polyimide humidity sensing film, thereby partially  
15 exposing the polyimide thin film.

Accordingly, the vapor is directly in contact with the polyimide humidity sensing film exposed between the upper electrodes, so as to be propagated into the thin film.

The polyimide has a relative dielectric constant of 3 to 4 at a room  
20 temperature. Also, the polyimide has a dissipation factor value of 0.001~0.003 at the frequency of 1kHz. Accordingly, the polyimide has a stable dielectric property.

In the present invention, since the polyimide humidity sensing film acts as a dielectric of a capacitor, dielectric mixtures having different  
25 dielectric constants are formed within the polyimide thin film if the aqueous molecule having a relative dielectric constant of 80 is

propagated into the polyimide thin film.

Thus, the relative dielectric constant of the dielectric mixtures is varied depending on variation of the peripheral humidity, so that the humidity variation can be detected.

5 Finally, a ceramic thin film such as  $\text{SiO}_2$ ,  $\text{Si}_3\text{N}_4$ , and  $\text{SiO}_x\text{N}_y$  is deposited on the humidity sensing film 14' for a temperature compensating element and the upper electrode 15' and then patterned, so that the humidity is not propagated into the humidity sensing film 14'. Thus, a passivation film 16 is formed.

10 In the capacitance type absolute humidity sensor fabricated as above, it is noted that, as shown in Fig. 3b, the humidity sensing element and the temperature compensating element are formed on the same silicon substrate 11.

Figs. 4a and 4b show a package structure of an absolute humidity  
15 sensor according to the present invention, in which one example of the resistance type absolute according to the first embodiment of the present invention is shown.

As shown in Fig. 4a, an absolute humidity sensor element 19 provided with a humidity sensing element 18 and a temperature compensating element  
20 18 as fabricated by the method of the first embodiment is joined with a printed circuit board 20. Electrodes 8 and 8' of the elements are wire-bonded to an electrode 21 of the printed circuit board 20. Afterwards, as shown in Fig. 4b, a shield wire 22 is connected to the printed circuit board 20. The shield wire 22 and the printed circuit board  
25 20 are sealed with a metal shield case 23 having a hole to propagate the humidity thereinto. Thus, the package of the absolute humidity sensor is

completed.

Fig. 5 is a circuit diagram for detecting variation of the peripheral humidity based on the resistance type absolute humidity sensor according to the present invention. The circuit for detecting variation of the peripheral humidity includes a bridge circuit and a power source V applied to the bridge circuit. The bridge circuit consists of a humidity sensing element 17, a temperature compensating element 18, a fixed resistor R1, and a variable resistor VR.

As an example, a method for detecting variation of the humidity by the water vapor generated from food during cooking of food in a microwave oven using the absolute humidity sensor and the above circuit will be described below.

First, if the food is heated in the microwave oven, the water vapor is generated. The generated water vapor is propagated into the metal shield case 23 through the hole formed therein. Thus, the water vapor is in contact with the humidity sensing element 17 and the temperature compensating element 18.

At this time, the humidity sensing element 17 has a varied resistance as the humidity is absorbed in the polyimide. However, the temperature compensating element 18 does not have a varied resistance as the humidity is not absorbed in the polyimide due to the passivation film.

The resistance variation of the humidity sensing element 17 causes output variation of the bridge circuit, thereby detecting the humidity variation.

Accordingly, the humidity variation around the sensor can easily be detected by the absolute humidity sensor and the above circuit. The water

vapor generated from the food due to heat during cooking of food in a cooking machine such as a microwave oven is detected to apply for automatic cooking of food.

#### 5 Industrial Applicability

As aforementioned, the absolute humidity sensor according to the present invention has the following advantages.

The polyimide thin film, which absorbs the humidity greater than a ceramic based humidity sensing material, is used as a humidity sensing material, and a silicon wafer is used as a substrate. Thus, an absolute humidity sensor susceptible to humidity can be fabricated and at the same time the sensor can be integrated using a silicon process. This simplifies the package process and facilitates mass production of the sensor.

15 The foregoing embodiments are merely exemplary and are not to be construed as limiting the present invention. The present teachings can be readily applied to other types of apparatuses. The description of the present invention is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations  
20 will be apparent to those skilled in the art.

What is claimed is:

1. An absolute humidity sensor comprising:

a silicon substrate;

a humidity sensing element formed on a substrate, for detecting  
5 humidity exposed to the air, having a variable resistance value depending  
on the amount of the detected humidity;

a temperature compensating element formed on the semiconductor,  
for compensating for the resistance value of the humidity sensing  
element; and

10 a passivation film covered on the temperature compensating element,  
for shielding the humidity exposed to the air so as not to vary the  
resistance value of the temperature compensating element.

2. The absolute humidity sensor of claim 1, wherein the humidity  
15 sensing element and the temperature compensating element include:

an insulating film formed on the substrate;

a humidity sensing film formed on the insulating film, for  
absorbing the humidity; and

an electrode formed below the humidity sensing film or over/below  
20 the humidity sensing film.

3. The absolute humidity sensor of claim 2, wherein the insulating  
film is formed of any one of  $\text{SiO}_2$ ,  $\text{Si}_3\text{N}_4$ , and  $\text{SiO}_x\text{N}_y$ .

4. The absolute humidity sensor of claim 2, wherein the humidity sensing film is formed of polyimide.

5 5. The absolute humidity sensor of claim 2, wherein the electrode has a comb shape.

6. The absolute humidity sensor of claim 2, wherein the electrode formed only over the humidity sensing film has a comb shape.

10

7. The absolute humidity sensor of claim 1, wherein the passivation film is formed of any one of  $\text{SiO}_2$ ,  $\text{Si}_3\text{N}_4$ , and  $\text{SiO}_x\text{N}_y$ .

8. The absolute humidity sensor of claim 1, further comprising:  
15 a printed circuit board joined with a lower portion of the silicon substrate;

a wire for electrically connecting electrodes of the humidity sensing element and the temperature compensating element with electrodes of the printed circuit board; and

20 a metal shield case formed over the printed circuit board to cover an entire surface of the printed circuit board including the humidity sensing element and the temperature compensating element.

9. The absolute humidity sensor of claim 8, wherein the metal shield  
25 case has a hole for propagation of external humidity.